CLAIMS

What is claimed is:

1. A low phase-noise oscillator comprising:

a frequency generator to generate a reference signal at an oscillation frequency responsive to a control signal;

a delay element comprising a high-temperature superconductor to time-delay the reference signal and provide a low phase-noise time-delayed reference signal; and

a phase detector to generate the control signal from a phase difference between the low phase-noise time-delayed reference signal and a phase-shifted reference signal.

2. The oscillator of claim 1 wherein the high-temperature superconductor is disposed on a semiconductor substrate to provide the low phase-noise time-delayed reference signal when cooled to within a cryogenic-temperature range.

3. The oscillator of claim 2 wherein the delay element comprises a coplanar waveguide comprising the high-temperature superconductor, the coplanar waveguide to operate as a delay line to provide the low phase-noise time-delayed reference signal when cooled to within the cryogenic temperature range.

4. The oscillator of claim 3 wherein the coplanar waveguide is arranged on the semiconductor substrate in a substantially random pattern.

5. The oscillator of claim 1 further comprising a cooling element to reduce the temperature of the delay element.

6. The oscillator of claim 5 wherein the cooling element reduces the temperature of the delay element to within a cryogenic temperature range.

7. The oscillator of claim 2 wherein the high-temperature superconductor comprises Yttrium-Barium-Copper Oxide, and wherein the substrate comprises either Lanthanum-Aluminum Oxide or Magnesium Oxide.

8. The oscillator of claim 7 wherein the delay element time-delays the reference signal and provides the low phase-noise time-delayed reference signal when cooled to a cryogenic temperature ranging between 30 and 120 degrees Kelvin.

9. The oscillator of claim 1 wherein the frequency generator is a voltage controlled oscillator (VCO), and the control signal is a control voltage generated by the phase detector.

10. The oscillator of claim 9 wherein the frequency generator is surface acoustic wave (SAW) VCO.

11. The oscillator of claim 10 further comprising a phase shifter to phase shift the reference signal to generate the phase-shifted reference signal,

wherein the phase shifter is a variable phase shifter to generate the phase-shifted reference signal having approximately ninety-degree phase difference from the time-delayed reference signal.

12. The oscillator of claim 11 further comprising:

a signal splitter to split the reference signal from the frequency generator and provide the reference signal to both the phase shifter and delay element; and

a low-pass filter to filter the control signal and provide a filtered control signal to the frequency generator.

13. The oscillator of claim 12 wherein:

the delay element comprises a coplanar waveguide comprising the high-temperature superconductor, the coplanar waveguide to operate as a delay line to provide the low phase-noise time-delayed reference signal when cooled to a cryogenic temperature;

the coplanar waveguide has a length between 100 and 1000 meters to provide the time delay ranging from between five and fifteen microseconds;

the substrate has a diameter of between approximately 5 and 13 centimeters and the coplanar waveguide is arranged on the substrate in a substantially random pattern;

the high-temperature superconductor comprises Yttrium-Barium-Copper Oxide to be cooled to approximately 77 degrees Kelvin, and the substrate comprises either Lanthanum-Aluminum Oxide or Magnesium Oxide; and

the oscillation frequency comprises a frequency between approximately 500 Mega-Hertz and six Giga-Hertz.

14. A receiver comprising:

a radio-frequency section to down-convert received RF signals using a low phase-noise reference signal; and

an oscillator to generate the low phase-noise reference signal at an oscillation frequency, the oscillator comprising a frequency generator to generate the reference signal responsive to a control signal, a delay element comprising a high-temperature superconductor to time-delay the reference signal and provide a low phase-noise time-delayed reference signal when cooled to a cryogenic temperature, and a phase detector to generate the control signal from a phase difference between the time-delayed reference signal and a phase-shifted reference signal.

15. The receiver of claim 14 wherein the low phase-noise reference signal exhibits deviations of less than approximately 125 dBc/Hz at 10 KHz for a Ka-band oscillation frequency, and less than approximately 135 dBc/Hz at 10 KHz for an X-band oscillation frequency.

16. The receiver of claim 15 wherein the delay element comprises a coplanar waveguide comprising the high-temperature superconductor, the coplanar waveguide to operate as a delay line to provide the low phase-noise time delayed reference signal when cooled to within a cryogenic temperature range.

17. The receiver of claim 16 wherein the coplanar waveguide is arranged on a semiconductor substrate in a substantially random pattern to provide a time-delay of between 5 and 15 microseconds.

18. The receiver of claim 17 further comprising a cooling element to reduce the temperature of the delay element to within the cryogenic temperature range.

19. The receiver of claim 18 wherein the receiver is part of a radar system to detect low-Doppler radar signals.

20. A method of generating a low phase-noise reference signal comprising:

generating a reference signal at an oscillation frequency in response to a control signal;

time delaying the reference signal with a delay element comprising a high-temperature superconductor cooled to within a cryogenic temperature range to generate a low phase-noise time-delayed reference signal; and

generating the control signal from a phase difference between the time-delayed reference signal and a phase-shifted reference signal.

21. The method of claim 20 wherein time delaying comprises time delaying the reference signal through a coplanar waveguide comprising the high-temperature superconductor, the coplanar waveguide operating as a delay line to provide the low phase-noise time-delayed reference signal when cooled to within the cryogenic temperature range.

22. The method of claim 21 further comprising cryogenically cooling the delay element to generate the low phase-noise time-delayed reference signal.

23. The method of claim 21 further comprising:

phase shifting the reference signal to generate the phase-shifted reference signal to have approximately ninety-degree phase difference from the low phase-noise time-delayed reference signal;

low-pass filtering the control signal; and

controlling a frequency generator with the filtered control signal to generate the reference signal.